RESEARCH REPORT

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The Impact of IXL on High School Math and ELA Learning in California

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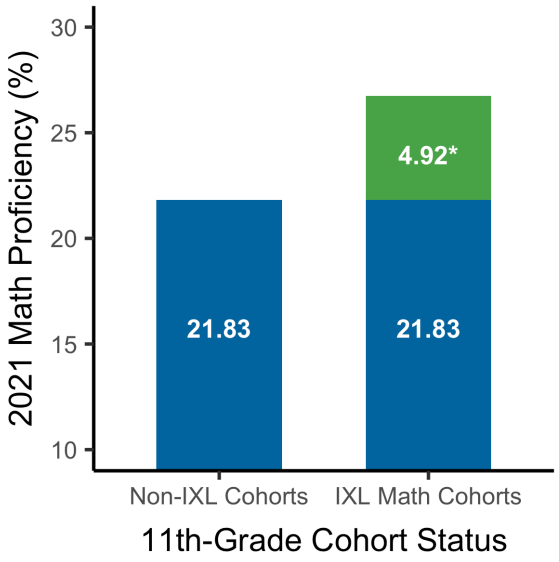
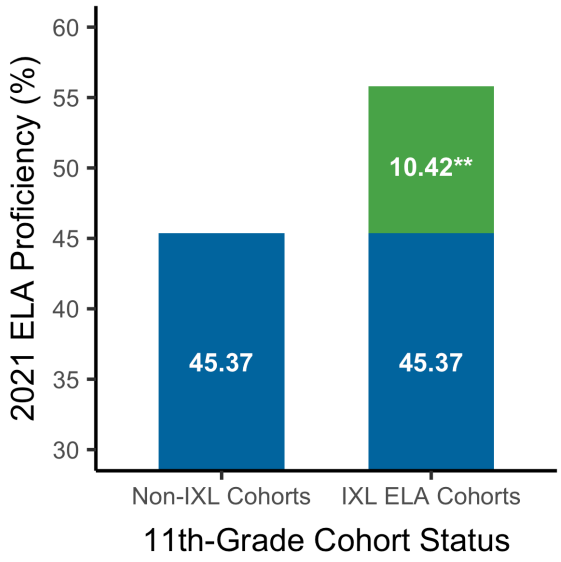
Executive Summary

IXL is a personalized learning platform designed to help students build academic skills in subjects including math and English language arts (ELA). Previous research has shown that IXL can have a significant positive impact on students' academic performance (e.g., Empirical Education, 2013).

The goal of this study was to examine IXL usage among high school students in California and its relation to academic performance in math and ELA, as measured by the Smarter Balanced Summative Assessment (SBA). At the high school level in California, the SBA is taken only by 11th-grade students each year. We analyzed students' math and ELA SBA performance, using 2019 as the pretest year and 2021 as the posttest year. The key finding is[1]:

- **IXL implementation improves student achievement.** Eleventh-grade cohorts that used IXL Math or IXL ELA performed better on SBA Math and SBA ELA, respectively, than comparable cohorts that did not use IXL. Specifically, the proficiency rate[2] was nearly five percentage points higher for IXL Math cohorts and more than ten percentage points higher for IXL ELA cohorts relative to cohorts not using IXL.





[1] *In all figures: * indicates significance at the .05 level, ** indicates significance at the .01 level*

[2] *Proficiency rate: percentage of students in a cohort classified as "Standard Met" or "Standard Exceeded" on the SBA.*

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Background

IXL is a powerful, flexible educational technology platform that provides personalized learning in four main subject areas—mathematics, English language arts (ELA), science, and social studies—for students in grades pre-K through 12. Currently, IXL is used by about 1 in 5 students in the U.S. and by over 13 million students worldwide. Deeply rooted in learning sciences research (see Bashkov et al., 2021), IXL engages each student in a personalized learning experience tailored to their working level. As a result, students work through problems that are neither too easy nor too difficult, which in turn supports their self-efficacy and motivation for continued learning.

The goal of this study was to examine the efficacy of IXL Math and IXL ELA at the high school level in California. Specifically, we investigated the efficacy of IXL by comparing Smarter Balanced Summative Assessment (SBA) proficiency rates among 11th-graders in high schools that had used IXL to those of comparable 11th-graders in high schools that had not used IXL.

Methodology

STUDY DESIGN

In this study, we used a quasi-experimental pretest-posttest control group design to compare the proficiency rates of 11th-grade cohorts in schools that had used IXL during the 2019-2020 and 2020-2021 school years to the proficiency rates of cohorts in schools that did not use IXL at all during this time (Figure 1). To control for baseline performance and demographic characteristics, we used one-to-one propensity score matching (described in more detail below) to match each IXL cohort to a similar cohort that did not use IXL.

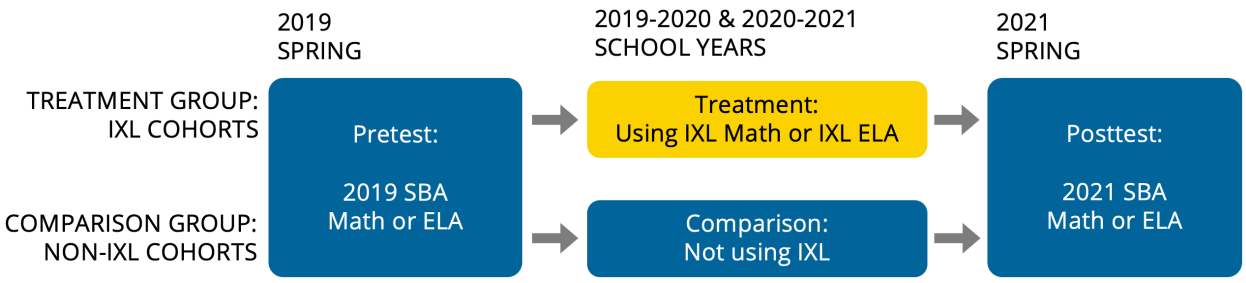

Figure 1. Study Design

PARTICIPANTS

Because students in 11th grade are the only high school students to take the SBA in California each year, we identified schools with 11th-grade cohorts who used IXL during the study period (i.e., the 2019-2020 and 2020-2021 school years). We defined IXL cohorts as those in which 11th-grade students answered an average of at least 5 questions per student per week during the study period. This threshold allowed us to accommodate a wide variety of usage levels, maximizing the generalizability of the study; at the same time, it ensured that we would not include grade cohorts with extremely low usage. We defined comparison cohorts as those in which 11th-grade students did not use IXL at all during the study period. Using these criteria, we obtained a sample of 104 study cohorts for the IXL Math analysis (treatment n = 52, comparison n = 52) and 48 study cohorts for the IXL ELA analysis (treatment n = 24, comparison n = 24) after propensity score matching.

PROPENSITY SCORE MATCHING

We conducted one-to-one propensity score matching without replacement using the *MatchIt* package in *R* (Ho et al., 2011; R Core Team, 2021) as a preprocessing step prior to analysis. A *propensity score* is the probability that a school would be assigned to the treatment (i.e., IXL) group over the comparison group and is calculated using a combination of demographic characteristics (i.e., covariates). In the absence of random assignment, propensity scores can be used to match comparison schools to treatment schools and create equivalent treatment and comparison groups. In a comparison of unmatched groups (e.g., IXL cohorts compared to all non-IXL cohorts), non-IXL cohorts could be very different from IXL cohorts on some dimensions. In contrast, using propensity score matching allows us to compare the performance of pairs of IXL and non-IXL cohorts that are very similar to each other. This comparison allows for a clearer attribution of the effect of IXL and broader generalization of the findings to other cohorts that are not yet using IXL. Comparison cohorts were identified from 741 (math) and 795 (ELA) non-treatment schools in the state that had non-missing posttest and demographic data for students in 11th grade. After matching, the resulting treatment and comparison groups for math and ELA had extremely similar demographic characteristics (see Table A1, Appendix A).

DATA SOURCES

Assessment and Demographic Data

All assessment and demographic data were obtained from the California Department of Education. Math and ELA performance at pretest (2019) and posttest (2021) was measured using the Smarter Balanced Summative Assessment (SBA), a standardized assessment administered annually to California students in Grade 11 (as well as students in Grades 3-8; this report focuses on the high school level). The outcome measure that we used was the percentage of 11th-graders within a school reaching proficiency in math or ELA. The SBA is one of the assessments administered as part of the California Assessment of Student Performance and Progress (CAASPP) System; more information about the SBA and CAASPP can be found at https://www.cde.ca.gov/ta/tg/ai/cefcaaspp.asp.

Following What Works Clearinghouse recommendations (WWC, 2018, 2020), we matched treatment and comparison cohorts on baseline performance (11th-grade proficiency rate on 2019 SBA Math or SBA ELA), as well as gender (percentage of male students) and race (percentage of white students). Because only 11th-grade students take the SBA in high school each year, it was not necessary to control for grade level.

IXL Usage Data

IXL usage data were obtained from IXL's internal database. When students use IXL, they complete practice problems organized within "skills," or specific topic areas within a subject, and IXL uses a proprietary *SmartScore* to indicate a student's proficiency within a skill. The SmartScore ranges from 0-100 and increases as students answer questions correctly. However, it is not a percent correct score; a SmartScore of 100 is always possible. A SmartScore of 80 indicates proficiency in a skill, and a SmartScore of 100 indicates mastery. In addition to skill proficiency data, we also examined the amount of time that students spent using IXL and the number of questions they answered. Descriptive statistics for IXL usage during the study period can be found in Table 1.

Table 1. **Usage of IXL Math and IXL ELA among treatment cohorts**

IXL usage (per student per week)	IXL Math (*n* = 52)				IXL ELA (*n* = 24)			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max
Time spent (in minutes)	9.42	6.41	2.65	36.68	4.79	2.44	1.47	11.71
Questions answered	13.53	12.12	5.09	74.85	10.80	7.77	5.02	34.01
Skills proficient	0.26	0.22	0.07	1.42	0.19	0.14	0.07	0.57

Sample Sizes and Missing Data

It should be noted that the 2021 SBAs were administered during the COVID-19 pandemic, which has caused ongoing disruptions to learning and assessment. Missing assessment data are not specific to the pandemic, but the pandemic likely played a major role in students not completing state assessments. In 2019, 17.5% of California high schools in this dataset were missing SBA data (442 of 2,525 schools); in 2021, the number of schools without assessment data rose sharply, with close to 50% of all high schools missing 2021 SBA data (1,255 of 2,525 schools). In addition, because we used grade-level (rather than school-level) demographic data, this information was sometimes masked due to the small number of students in 11th grade in some schools.

ANALYSIS

We specified and tested separate multilevel models for IXL Math and IXL ELA to account for clustering at the district level (i.e., grade cohorts within a district tend to be more similar to each other than grade cohorts in other districts). In these models, we regressed the 2021 11th-grade proficiency rate on IXL cohort status (treatment or comparison) and covariates (baseline performance and demographic characteristics). We included covariates in the models because the absolute standardized mean differences (SMDs) for some covariates were greater than .05 after

matching, indicating that these differences needed to be accounted for statistically. Following WWC guidelines, we computed effect sizes (Hedges' *g*) using model-adjusted (i.e., estimated) means and the pooled unadjusted (i.e., observed) standard deviation (WWC, 2020). In addition, the ELA effect size calculation includes WWC's recommended small sample size correction because the total sample size is less than 50 (WWC, 2020). Given that these analyses are at the grade cohort level (i.e., 11th-grade students), these effect sizes should be interpreted at the grade cohort level as well.

Results

Efficacy of IXL Math. We found that 11th-grade cohorts that used IXL Math outperformed non-IXL cohorts on the 2021 SBA math assessment—specifically, the proficiency rate was nearly five percentage points higher for IXL Math cohorts relative to cohorts not using IXL (Figure 2). The estimated treatment effect for IXL Math was positive and statistically significant (b = 4.92, p = .022; see Table B1 in Appendix B for full model results). The effect size (Hedges' *g*) was .28.

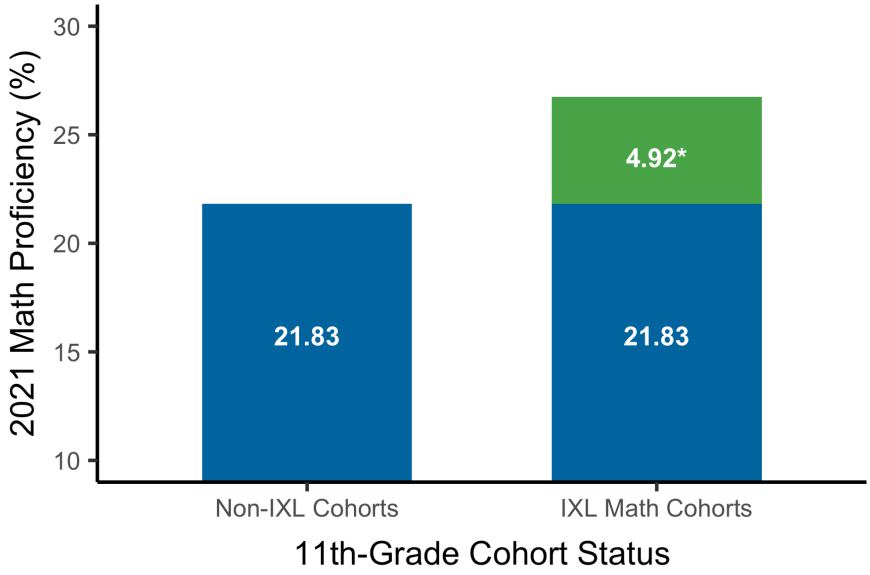

Figure 2. The efficacy of IXL Math

Efficacy of IXL ELA. Similar to IXL Math cohorts, 11th-grade cohorts who used IXL ELA also outperformed their non-IXL peers on SBA ELA at posttest—specifically, the proficiency rate was more than ten percentage points higher for IXL ELA cohorts relative to cohorts not using IXL (Figure 3). The estimated treatment effect for IXL ELA was positive and statistically significant (b = 10.42, p = .002; see Table B2 in Appendix B for full model results). The effect size (Hedges' g) was .57.

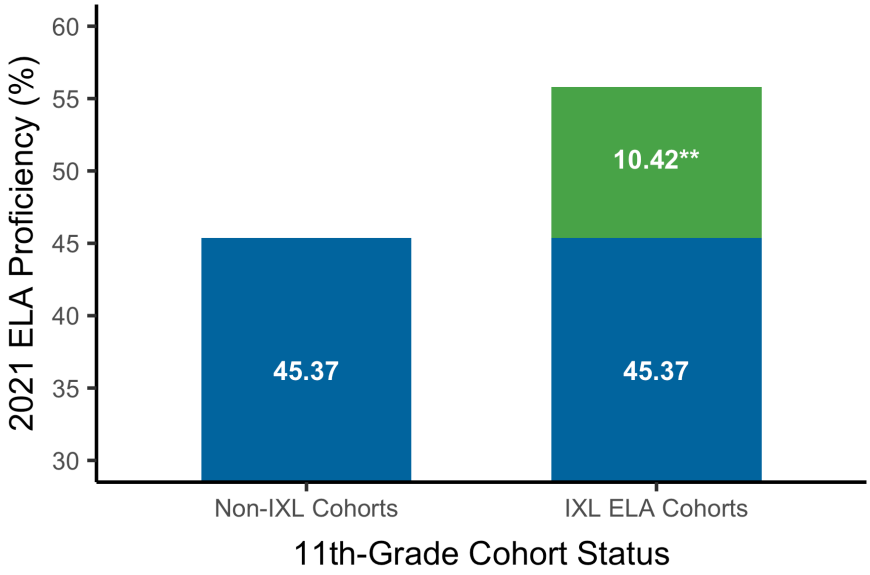

Figure 3. The efficacy of IXL ELA

Discussion

In this study, we investigated the efficacy of IXL Math and IXL ELA across 11th-grade cohorts in California public high schools. We found that students who used IXL performed significantly better on the SBA than students who did not use IXL, controlling for baseline performance and demographics. These results add to the large body of evidence that IXL is a highly effective way to bolster students' learning (e.g., An, 2021a, 2021b; IXL Learning, 2019, 2020).

In this sample, students' usage of IXL was somewhat lower than IXL's recommendation of reaching proficiency in two skills per week. Nevertheless, we found strong effects of IXL usage, showing that IXL is a powerful educational tool even in small doses. Because interventions are more effective when they are carried out with fidelity (e.g., Noell et al., 2002; see Finney et al., 2021), we anticipate that students would experience even greater gains when IXL is used as recommended.

The COVID-19 pandemic has caused widespread disruptions in education, and many educators have expressed concern that students will show greater-than-normal knowledge gaps or learning loss as a result of these disruptions (e.g., Engzell et al., 2021). Indeed, we found that the overall proficiency rates of the comparison cohorts in this sample decreased in both math (24% in 2019 to 22% in 2021)

and ELA (44% in 2019 to 42% in 2021). However, we found that IXL usage attenuated the adverse effects of learning disruptions due to the pandemic: in fact, students in IXL cohorts showed slightly *higher* proficiency rates relative to pretest (math: 25% in 2019 to 26% in 2021; ELA: 48% in 2019 to 51% in 2021). IXL has helped students continue to learn because it provides a unique approach to personalized learning. With its adaptive software that analyzes students' response patterns during practice, IXL recognizes content areas where students may be struggling and engages them with material at the appropriate level.

By meeting students where they are, IXL can help students "catch up" by providing support for relearning missed or forgotten material. This combination of personalized learning and remediation has been suggested as a highly effective approach for both recovering from pandemic-related learning loss as well as boosting future learning gains (Kaffenberger, 2021). For students in high school, who are likely preparing for high-stakes college entrance exams in addition to state assessments, continuing to use IXL will support both their current and future academic success.

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Appendix A: Demographics

Table A1. Demographic characteristics of treatment (IXL) and comparison (non-IXL) groups

	Math		ELA	
	IXL Cohorts	Non-IXL Cohorts	IXL Cohorts	Non-IXL Cohorts
Pretest and posttest	*N* = 52	*N* = 52	*N* = 24	*N* = 24
2019 % proficient	24.69 (15.40)	24.90 (20.43)	48.31 (17.70)	44.36 (20.65)
2021 % proficient	25.90 (16.14)	21.82 (19.06)	51.10 (17.35)	42.38 (18.78)
School-level characteristics				
School location				
City	34 (65.38%)	22 (42.31%)	19 (79.17%)	8 (33.33%)
Suburb	14 (26.92%)	21 (40.38%)	4 (16.67%)	10 (41.67%)
Town	2 (3.85%)	4 (7.69%)	1 (4.17%)	2 (8.33%)
Rural	2 (3.85%)	5 (9.62%)	0 (0.00%)	4 (16.67%)
Title I school	48 (92.31%)	46 (88.46%)	22 (91.67%)	48 (77.42%)
% Low-SES students	78.80 (19.14)	70.93 (21.87)	81.89 (19.03)	80.53 (14.51)
Grade-level demographics				
Grade size (N students)	338.54 (187.51)	261.87 (229.14)	366.38 (177.29)	234.46 (208.60)
Race (% white)	11.84 (13.35)	12.04 (14.68)	9.80 (12.73)	8.86 (12.58)
Gender (% male)	53.24 (6.29)	53.47 (9.42)	52.57 (7.02)	53.33 (9.57)
% ELL	11.75 (7.19)	15.82 (9.33)	15.76 (10.90)	18.18 (11.62)

Note. Numbers in parentheses show standard deviations for continuous variables. SES = socioeconomic status. ELL = English language learners.

Appendix B: Model Results

Table B1. Full IXL Math efficacy model

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	21.83	1.61	18.69 – 24.94	-0.11	13.54	<.001
Gender: % male[1]	-0.18	0.14	-0.46 – 0.10	-0.08	-1.34	0.185
Race: % white[1]	-0.03	0.09	-0.21 – 0.15	-0.02	-0.31	0.757
2019 SBA Math % proficient[1]	0.78	0.07	0.65 – 0.92	0.79	11.59	<.001
IXL Math cohort	**4.92**	**2.12**	**0.80 – 9.00**	**0.28**	**2.32**	**.022**

Note. Dependent variable: Percent of 11th-graders reaching proficiency on 2021 SBA Math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient.

[1] Grand-mean centered.

Table B2. Full IXL ELA efficacy model

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	45.37	2.07	41.42 – 49.34	-0.07	21.88	<.001
Gender: % male[1]	-0.26	0.18	-0.60 – 0.09	-0.12	-1.43	.159
Race: % white[1]	0.07	0.12	-0.15 – 0.30	0.05	0.59	.557
2019 SBA ELA % proficient[1]	0.76	0.08	0.60 – 0.92	0.79	9.22	<.001
IXL ELA cohort	**10.42**	**3.22**	**3.76 – 16.68**	**0.57**	**3.23**	**.002**

Note. Dependent variable: Percent of 11th-graders reaching proficiency on 2021 SBA ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient.

[1] Grand-mean centered.